CLAIMS

What is claimed is:

1.   1.   A method for evaluating a plurality of moving queries over moving objects, the
2   queries and objects moving with respect to each other, the method comprising:
3   constructing a bounding box to contain each one of the plurality of moving
4   objects and moving queries;
5   creating an object index for each one of the plurality of moving objects and a
6   query index for each one of the moving queries using the corresponding bounding
7   box; and
8   evaluating the plurality of queries periodically using the query index to determine
9   which moving objects to include in each moving query evaluation.

1   2.   The method of claim 1, wherein the step of constructing the bounding box
2   comprises varying the size and shape of each bounding box based upon a speed
3   and a direction of motion of the corresponding moving object or moving query.

1   3.   The method of claim 1, wherein the step of constructing the bounding box
2   comprises placing the moving object or the moving query within the
3   corresponding bounding box in an initial position arranged to maximize the
4   length of time that each moving object and moving query is disposed within the
5   bounding box.

1   4.   The method of claim 1, wherein the step of constructing the bounding box
2   comprises constructing a rectangle for each moving object and moving query,
3   sizing the rectangle based upon a speed and a direction of motion of the
4   corresponding moving object or moving query, and placing the moving object or

5   moving query at a corner of the rectangle such that the direction of motion is
6   generally aligned with a diagonal of the rectangle.

1   5.   The method of claim 1, further comprising receiving at least one of location
2   information and motion information for each one of the moving objects and
3   moving queries, determining which moving objects and moving queries have
4   invalidated the corresponding bounding box based upon the received
5   information, and replacing invalidated bounding boxes with new bounding boxes.

1   6.   The method of claim 1, wherein the step of evaluating the moving queries
2   periodically comprises generating predictive query results.

1   7.   The method of claim 6, wherein the step of generating predictive query results
2   comprises creating a motion function for each moving query and each moving
3   object based upon a present location and a velocity vector associated with each
4   moving object and moving query, computing a predicted path for each moving
5   object and moving query based upon the associated motion function, comparing
6   the predicted paths to actual paths for the moving objects and queries and
7   computing new motion functions only when the predicted paths vary from the
8   actual paths by a pre-determined threshold value.

1   8.   The method of claim 6, wherein the step of generating predictive query results
2   comprises using the bounding boxes to determine which moving objects to
3   consider when generating the predictive query results.

1   9.   The method of claim 8, further comprising selecting moving objects for the
2   predictive query that have bounding boxes intersecting with a bounding box
3   associated with the query.

1	10.	The method of claim 1, wherein the step of periodically evaluating the moving
2		queries comprises maintaining a moving object table containing information
3		about the moving objects.

1	11.	The method of claim 10, wherein the step of evaluating the moving queries
2		further comprises scanning the moving object table and updating the moving
3		object index and the moving query index.

1	12.	The method of claim 1, wherein the step of periodically evaluating the moving
2		queries comprises maintaining a moving query table containing information
3		about the moving queries.

1	13.	The method of claim 12, wherein the step of evaluating the moving queries
2		further comprises scanning the moving query table and updating the moving
3		object index and the moving query index.

1	14.	A computer readable medium containing a computer executable code that when
2		read by a computer causes the computer to perform a method of evaluating a
3		plurality of moving queries over moving objects, the method comprising:
4		constructing a bounding box to contain each one of the plurality of moving
5		objects and moving queries;
6		creating an object index for each one of the plurality of moving objects and a
7		query index for each one of the moving queries using the corresponding bounding
8		box; and
9		evaluating the plurality of queries periodically using the query index.

1	15.	The computer readable medium of claim 14, wherein the step of constructing the
2		bounding box comprises varying the size and shape of each bounding box based

3		upon a speed and a direction of motion of the corresponding moving object or
4		moving query.

1	16.	The computer readable medium of claim 14, wherein the step of constructing the
2		bounding box comprises placing the moving object or moving query within the
3		corresponding bounding box in an initial position arranged to maximize the
4		length of time that each moving object and moving query is disposed within the
5		bonding box.

1	17.	The computer readable medium of claim 14, wherein the step of constructing the
2		bounding box comprises constructing a rectangle for each moving object and
3		moving query, sizing the rectangle based upon a speed and a direction of motion
4		of the corresponding moving object or moving query, and placing the moving
5		object or moving query at a corner of the rectangle such that the direction of
6		motion is generally aligned with a diagonal of the rectangle.

1	18.	The computer readable medium of claim 14, wherein the method further
2		comprises receiving at least one of location information and motion information
3		for each one of the moving objects and moving queries, determining which
4		moving objects and moving queries have invalidated the corresponding bounding
5		box based upon the received information, and replacing invalidated bounding
6		boxes with new bounding boxes.

1	19.	The computer readable medium of claim 14, wherein the step of evaluating the
2		moving queries periodically comprises generating predictive query results.

1	20.	The computer readable medium of claim 19, wherein the step of generating
2		predictive query results comprises creating a motion function for each moving
3		query and each moving object based upon a present location and a velocity vector

4   associated with each moving object and moving query, computing a predicted

5   path for each moving object and moving query based upon the associated motion

6   function, comparing the predicted paths to actual paths for the moving objects

7   and queries and computing new motion functions only for moving objects and

8   moving queries whose predicted paths vary from their actual paths by a pre-

9   determined threshold value.

1   21.   The computer readable medium of claim 19, wherein the step of generating

2   predictive query results comprises using the bounding boxes to determine which

3   moving objects to consider when generating the predictive query results.

1   22.   The computer readable medium of claim 21, wherein the method further

2   comprises selecting moving objects for the predictive query that have bounding

3   boxes intersecting with a bounding box associated with the query.

1   23.   The computer readable medium of claim 14, wherein the step of periodically

2   evaluating the moving queries comprises maintaining a moving object table

3   containing information about the moving objects.

1   24.   The computer readable medium of claim 23, wherein the step of evaluating the

2   moving queries further comprises scanning the moving object table and updating

3   the moving object index and the moving query index.

1   25.   The computer readable medium of claim 14, wherein the step of periodically

2   evaluating the moving queries comprises maintaining a moving query table

3   containing information about the moving queries.

1   26.   The computer readable medium of claim 25, wherein the step of evaluating the

2   moving queries further comprises scanning the moving query table and updating

3   the moving object index and the moving query index.

1   27.   A system for evaluating a plurality of moving queries over a plurality of moving

2   objects, the system comprising:

3   a plurality of moving objects;

4   a plurality of moving queries, each query associated with a spatial range;

5   a plurality of motion-adaptive bounding boxes, each bounding box associated

6   with one of the moving objects or moving queries;

7   at least one monitoring system capable of monitoring the location and motion of

8   the moving objects and moving queries and of evaluating the moving queries, the

9   monitoring system comprising a motion-adaptive query index and a motion-

10   adaptive object index.

1   28.   The system of claim 27, wherein the motion-adaptive bounding boxes are

2   adaptive to both the speed and frequency of changes in direction of the associated

3   moving object or moving query.

1   29.   The system of claim 27, wherein each moving query comprises a spatial range

2   and the spatial range is contained within the motion-adaptive bounding box

3   associated with the moving query.

1   30.   The system of claim 27, wherein the monitoring system further comprising a

2   moving object table and a moving query table containing information about the

3   moving objects and queries.

1   31.   The system of claim 30, wherein the monitoring system further comprises a logic

2   control unit for evaluating the moving queries, a receiver in communication with

3   the logic control unit for receiving information about the moving objects and

4   queries and a storage system in communication with the logic control unit for

5 .   storing the indexes and tables.